



NOAA
FISHERIES

Northwest Fisheries
Science Center

Demographically Independent Populations and Recovery

Puget Steelhead Technical Recovery Team (TRT)

May 30, 2013

It is apparent then that one of the first requirements of a sound conservation program must be the determination of the extent to which the species to be conserved is broken up into local populations. The defining of specific populations is concerned to a considerable extent with the determination of the geographical limits occupied by each.

Willis H. Rich, 1939
U.S. Bureau of Fisheries

The question is not, “Are populations important?”, but “how does one identify them?”

TRT Task: Population Identification

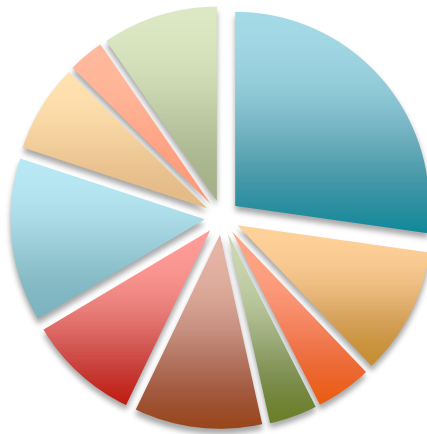
- Define and Identify Historical Demographically Independent Populations (DIPs)
- Define and Identify Major Population Groups (MPGs) containing one or more DIPs

Rationale

- DIPs provide a basic unit for recovery planning
- DIPs provide a basic unit for viability modeling
- MPGs provide a structure for conserving life history diversity
 - Capture geographic structure
 - Capture large scale ecological structure
- MPGs may represent a significant portion of the range (SPOR) and thus define an important metric for viability

Current vs. Historical: Shifting Paradigm

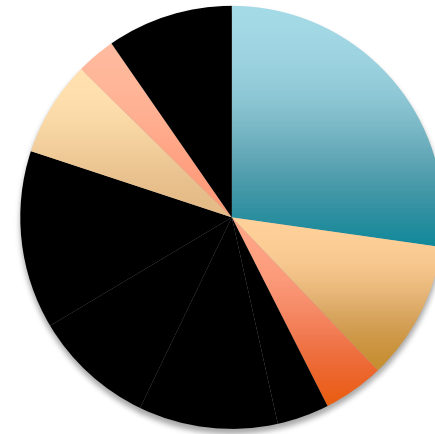
Historical Populations



Pop 1 Pop 2 Pop 3 Pop 4 Pop 5
Pop 6 Pop 7 Pop 8 Pop 9 Pop 10

Historical DPS contained 10 Populations

Current Populations



Pop 1 Pop 2 Pop 3 Pop 4 Pop 5
Pop 6 Pop 7 Pop 8 Pop 9 Pop 10

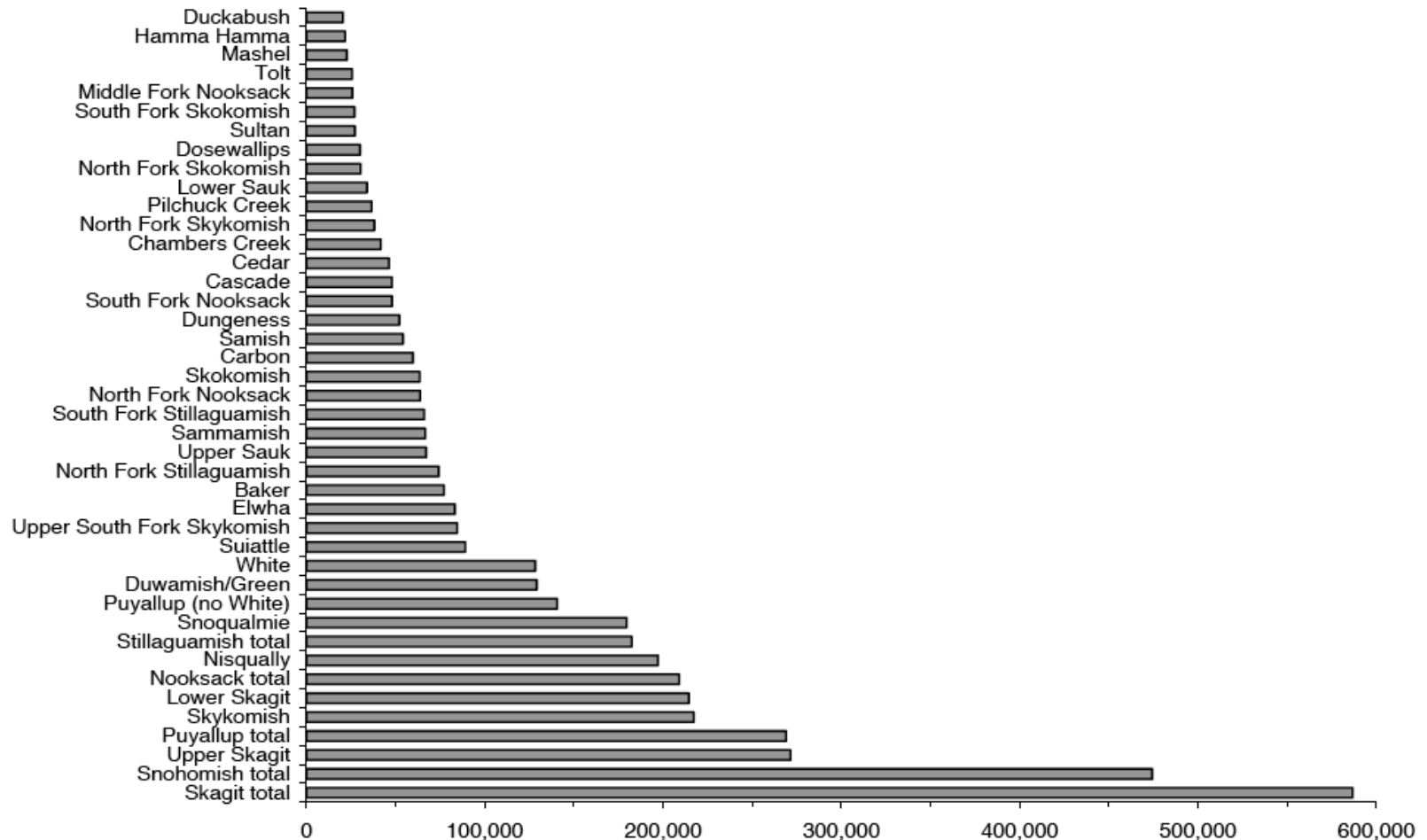
5 of 10 Historical Populations Extant

Primary issue is what is the baseline for establishing the requirements for a viable DPS?
Historical template is only “proven” template for viability, but that does not mean all of the component population need to be simultaneously viable.

Information Resources

- ❖ Geographic databases
 - ❖ Spatial separation, barriers, basin size
- ❖ Presence/Absence
- ❖ Catch records/punch cards
- ❖ Abundance (redd counts, dam/weir/smolt trap counts)
- ❖ Age Structure (scale sampling)
- ❖ Spawn timing
- ❖ Genetics (allozymes, microsatellite, etc)

Basin Size: Catchments, length, wetted area, etc

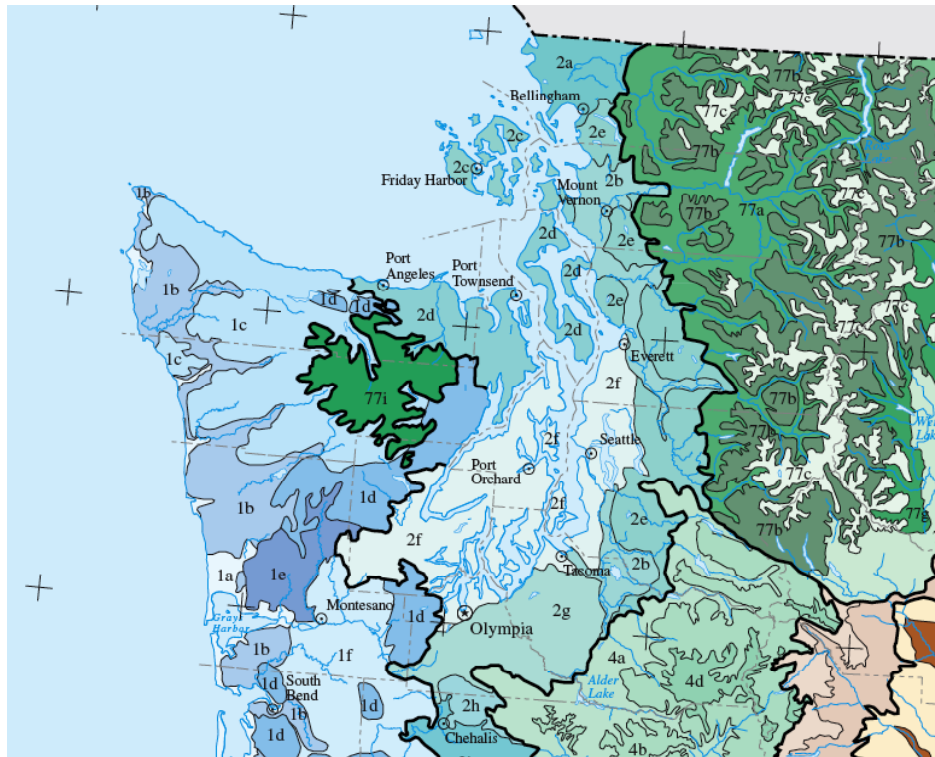


Definitive question becomes, what is the minimum size (ha) a basin needs to be to support a self-sustaining population? For Puget Sound, Snow Creek became the prototype small basin template.

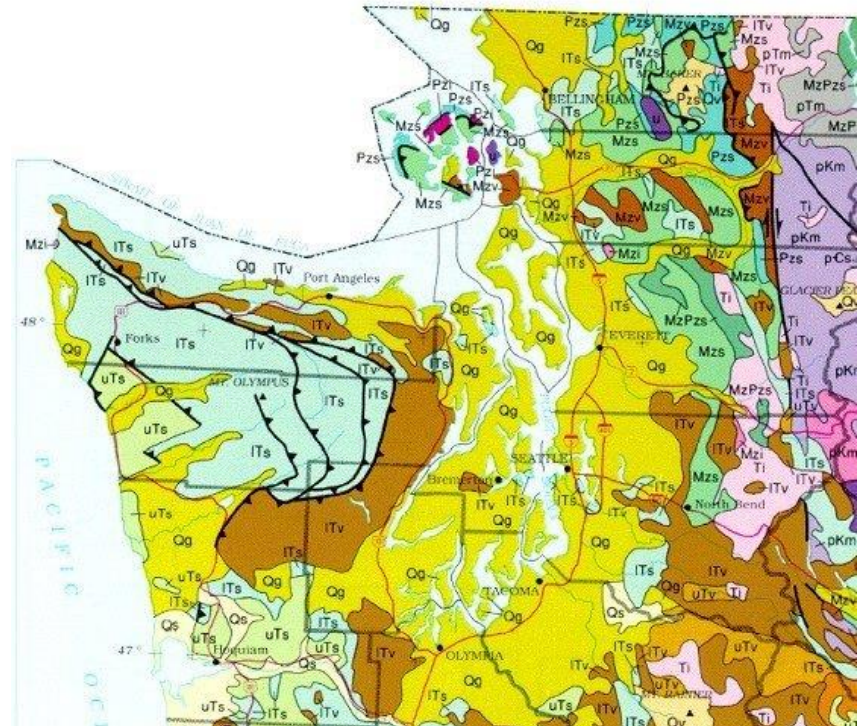


Information Resources:

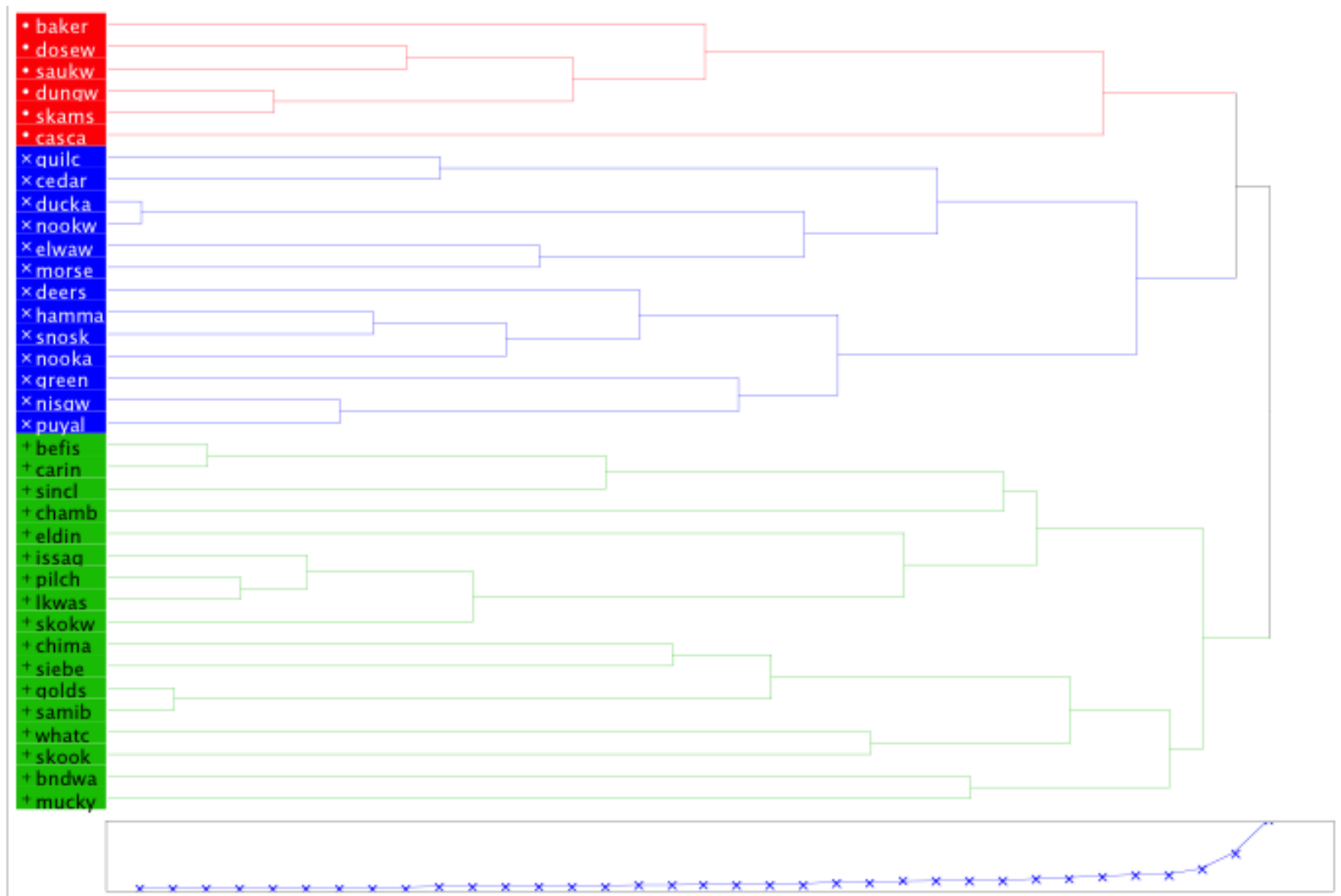
Ecoregions



Geology

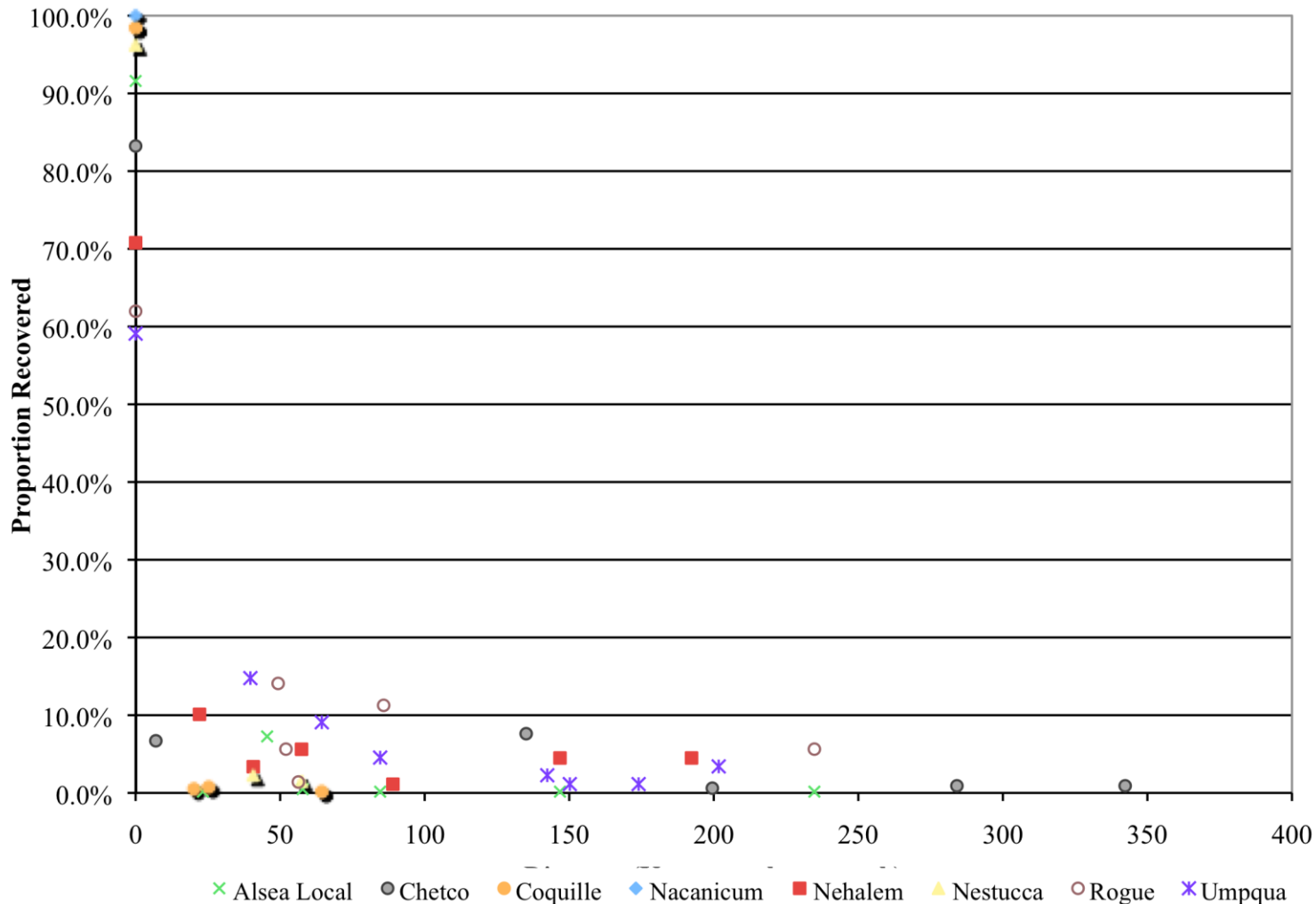


River Hydrology: Annual profiles



Isolation by Distance – Estimates of Homing Fidelity

Steelhead Homing Rates



Data from Schroeder et al. (2001)

Information Resources: Distribution



SURVEY REPORTS-----RIVERS & STREAMS

Hoods Canal River System

Name of River or Stream Union River or Creek

Source Springs and draught charges, Hoods Canal At Balfair Wash.

Approximate length Eleven miles all of importance Sect 32, R1N, T23N, W

Tributaries Two unnamed and of some importance, discharging at Sect 20, R1N, T23N; and Sect 9, of above 1. Respect.

Normal flow per second foot _____

General character of stream and its spawning area For the first six miles of its lower length Union River flows thru a fairly wide and flat-topped valley. An occasional squatter is located along its banks in this area but for the most part the banks are quite level and grow over with a heavy cover of brush and lowland trees. In this area the stream flow is medium fast over an excellent fine and coarse gravel bed. Approximately six miles from the mouth the stream enters a ravine (narrow) heavily wooded with virgin timber. This ravine gradually narrows and the sides become so steep that a box-shaped valley is formed in certain stretches of the stream's course. Then this portion, the creek falls becomes quite steep and the current is medium to swift as the water flows over the gravel and rock bed. Natural and artificial obstructions about nine miles from the mouth the creek enters a recently logged off area and continues thru many low logs in this logged and burned off watershed to its headwaters. The lumber companies are not pressing to exploit the entire area of the above mentioned stream timber ravine.

Located about seven miles from the mouth there is a series of three falls, the highest one being approximately 70 ft. direct, and the other two from six to ten ft. in height. Terminal point of salmon migration the above mentioned falls present a very definite termination of any run.

Sources of pollution _____

None

Diversions of water from the stream It is reported that Bremerton has rights on the river for the diversion of water for city use. However the only indication of any program in this line that was seen is a mess using weir constructional fishes across the river above just above the described series of falls. Any magnitude future construction of a dam periodicity of Run for diversions, however, that point would not effect the present natural run in the creek other than possibly lower the stream's discharge below the falls to the mouth and thus injure the migration in this manner.

Silver medium to large run Nov. and Dec

Sockeye _____

Humpback _____

Dog Small to medium run Aug, sept, and Oct.

Remarks concerning the runs and young fish A fairly large number of silver fry were seen thruout the creek to the falls.

Information Sources

SALMON FISHERIES OF PACIFIC COAST.

79

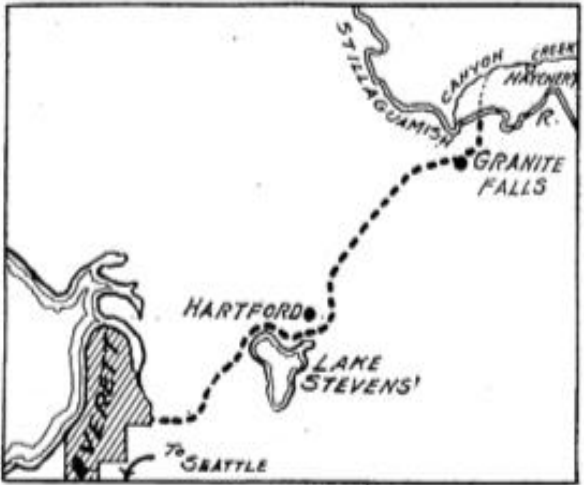
PRODUCTS OF THE SALMON FISHERIES OF WASHINGTON, BY APPARATUS, SPECIES, AND COUNTIES, IN 1909—Continued.

Apparatus and species.	Snohomish.		King.		Pierce.		Thurston.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
FURSE SEINES.								
Chinook, or king.	8,000	\$400			82,285	\$4,400	1,250	\$50
Coho, or silver.	159,998	4,400	766,000	\$21,175	513,340	13,833	54,396	1,510
Dog, or chum.	350,000	1,700	1,640,000	14,600	2,482,000	12,410	570,000	3,600
Sockeye, or blueback.	800,000	28,800	7,050,000	282,000	4,394,905	158,220	125,000	5,000
Steelhead trout.			14,100	957	10,400	520	400	20
Total.	1,317,998	35,300	9,470,100	318,062	7,483,020	189,383	751,046	10,180
HAUL SEINES.								
Chinook, or king.			65,500	4,585	18,743	1,312		
Coho, or silver.	155,250	3,125	364,000	11,000	462,000	13,000	60,000	2,000
Dog, or chum.	399,000	1,995	808,000	10,100	1,293,000	8,750	340,000	6,800
Humpback, or pink.	202,000	803						
Total.	756,250	5,623	1,237,500	25,685	1,773,743	23,062	400,000	8,800
GILL NETS.								
Chinook, or king.	337,900	12,104	49,500	3,900	30,000	2,400		
Coho, or silver.	438,256	16,480	555,000	18,500	240,000	10,250	90,000	3,000
Dog, or chum.	101,380	731	70,400	440	32,000	200	48,000	240
Humpback, or pink.			42,000	525				
Sockeye, or blueback.	142,243	9,293	335,500	13,420				
Steelhead trout.			205,000	12,300	100,000	10,000	30,000	1,500
Total.	1,019,779	38,608	1,257,400	49,145	408,000	22,850	168,000	4,740
TRAP NETS.								
Chinook, or king.	385,150	16,716						
Coho, or silver.	908,764	28,167						
Dog, or chum.	813,200	4,065						
Humpback, or pink.	354,000	1,383						
Steelhead trout.	27,000	1,350						
Total.	2,488,114	46,682						
LINES.								
Coho, or silver.	281,250	7,600						
TOTAL.								
Chinook, or king.	731,050	29,280	115,000	8,545	131,028	8,112	1,250	50
Coho, or silver.	1,943,518	54,672	1,685,000	50,675	1,221,340	37,083	204,396	6,510
Dog, or chum.	1,663,680	8,402	2,518,400	25,040	3,807,000	21,300	938,000	10,640
Humpback, or pink.	556,000	1,580	42,000	525				
Blueback, or sockeye.	800,000	28,800	7,385,500	295,420	4,394,905	158,220	125,000	5,000
Steelhead trout.	169,243	10,643	219,100	13,287	110,400	10,520	30,400	1,520
Grand total.	5,863,391	133,773	11,965,000	399,492	9,664,703	235,295	1,319,046	23,720

59395°—11—32

FISHING TRIPS OUT OF SEATTLE

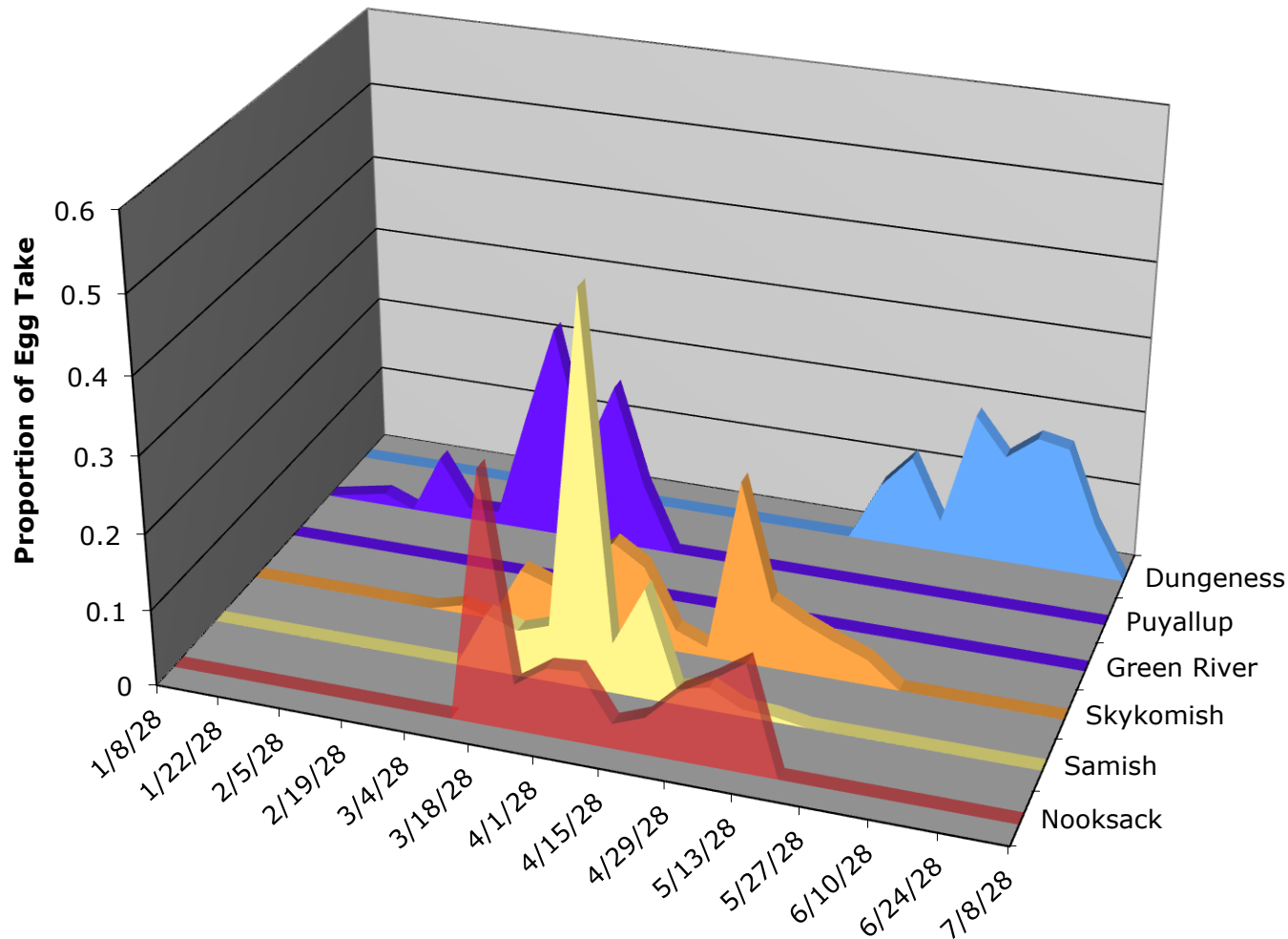
NO. 11
CANYON CREEK



CANYON CREEK represents the favorite hunt of the best of Seattle fishermen as well as of the biggest of Washington steelheads. No superlatives are too strong to describe the perfection of this stream, whose existence and possibilities have been kept secret by a favored few since its discovery about five years ago. Many anglers make the trip to Granite Falls, but scarcely any have heard of Canyon Creek, yet it empties into the Mollagumish river but a few hundred yards below the falls. Clear as crystal, with deep holes and a perfect setting, it offers an ideal home for the big fifteen and twenty pound steelhead. This is one spot where only the true Inak Walton may venture for to reach the happy fishing grounds it is necessary to travel a trail up from the falls for about three-quarters of a mile. This is not a place for campers or amateurs. It is a place for real fishermen, to whom a fight with one of the gamest fish that swims offers the spice of outdoor sport. Length of trip—by auto from Seattle it is fifty-six miles. Time—For average driver is two hours. The Route—Follow Pacific Highway out through University district to Holwell and Everett, a distance of about thirty-four miles. Follow main street through Everett and cross the Snohomish Valley bridge, which takes one over a gravel road for about two miles, when the paved highway is again reached. Follow right hand road at first V angle roadstead to Lake Stevens. From Lake Stevens to Hartford, and here the road meets the Snohomish highway, and the entire distance within two miles of Granite Falls is paved. Follow road through town to the Falls, which are four miles beyond.

and keep on road until a big steel bridge crossing the river just above the falls is reached. Turn right the place to leave the machines and start out on foot. Take first trail which turns off to the left a few paces beyond the bridge. Follow this for about three-quarters of mile through the woods. The hiking is not bad and a small log bridge over the creek should be reached in fifteen minutes easy. Two hundred yards above this bridge is the state hatchery and from the hatchery down stream to 200 yards below the bridge is considered the best steelhead fishing in the country by those who know. Fishing is at its best right now, but anglers must exercise considerable caution for the steelhead is a wary fish. The water is so clear that hundreds of these big fellows can be seen swimming about twenty feet below the surface, but they can see the fisherman just about as quickly, only the expert caster will get a strike. Size of Fish—These steelheads run big, averaging from seven to twenty pounds. Bait and Tackle—Best results are found with a natural single egg. Spoons and flies have not been nearly as successful. No feed eggs are necessary. The main thing to remember is to use light Phantom leaders and small hooks. No. 2, 3 and 4 Phantom leaders tied to No. 10 and 8 hooks are just right for this fishing. To land the big ones, the angler must allow about 15 yards of line for play, as the steelhead is a fighter and will make a run for it after being hooked. A landing net is also advised, as the light tackle makes any other method almost impossible.

Spawn time: Historical perspective



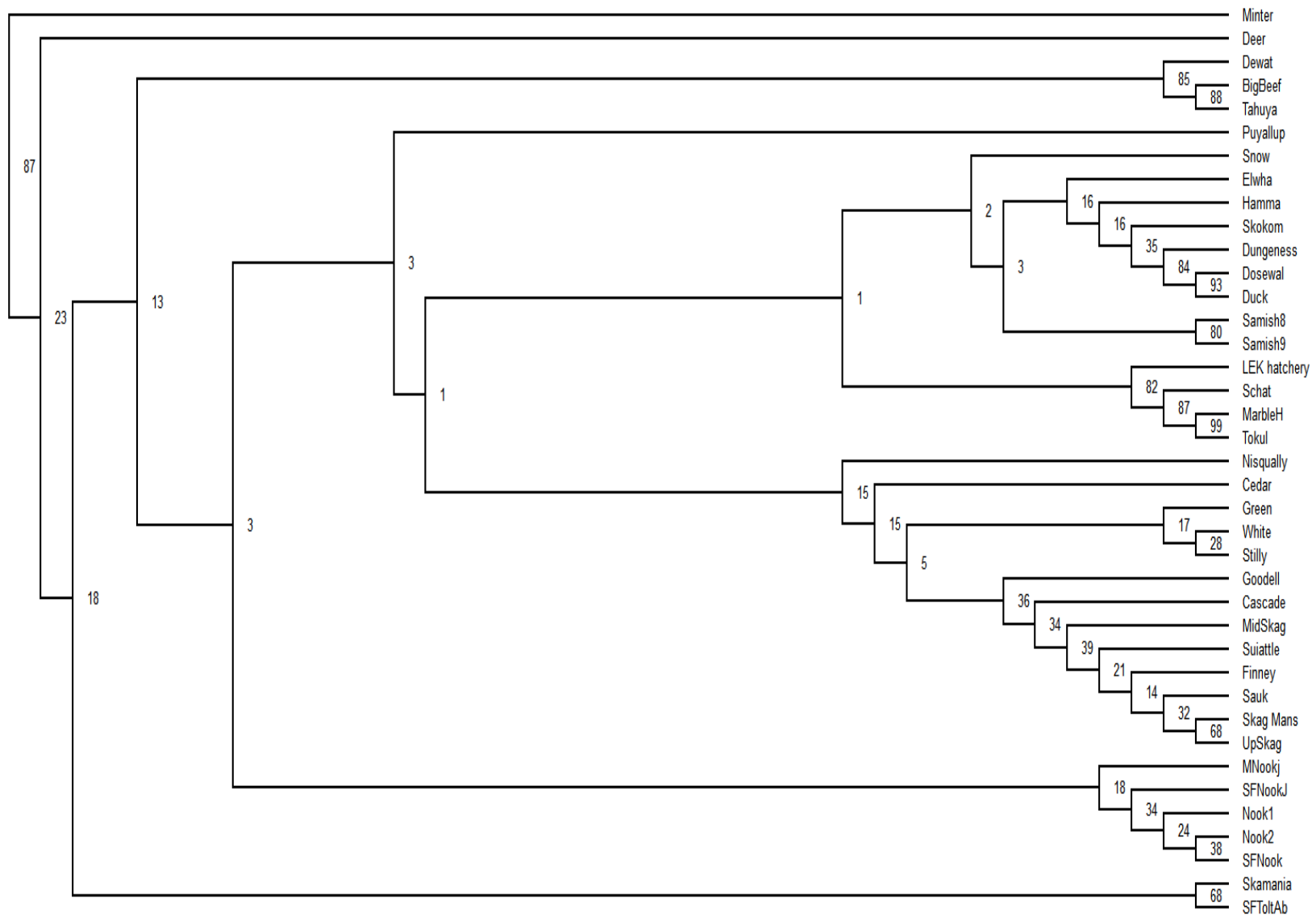
Timing of steelhead egg take at Washington Department of Fisheries Hatcheries 1932

DIP Determination: Genetics – CSE Distance

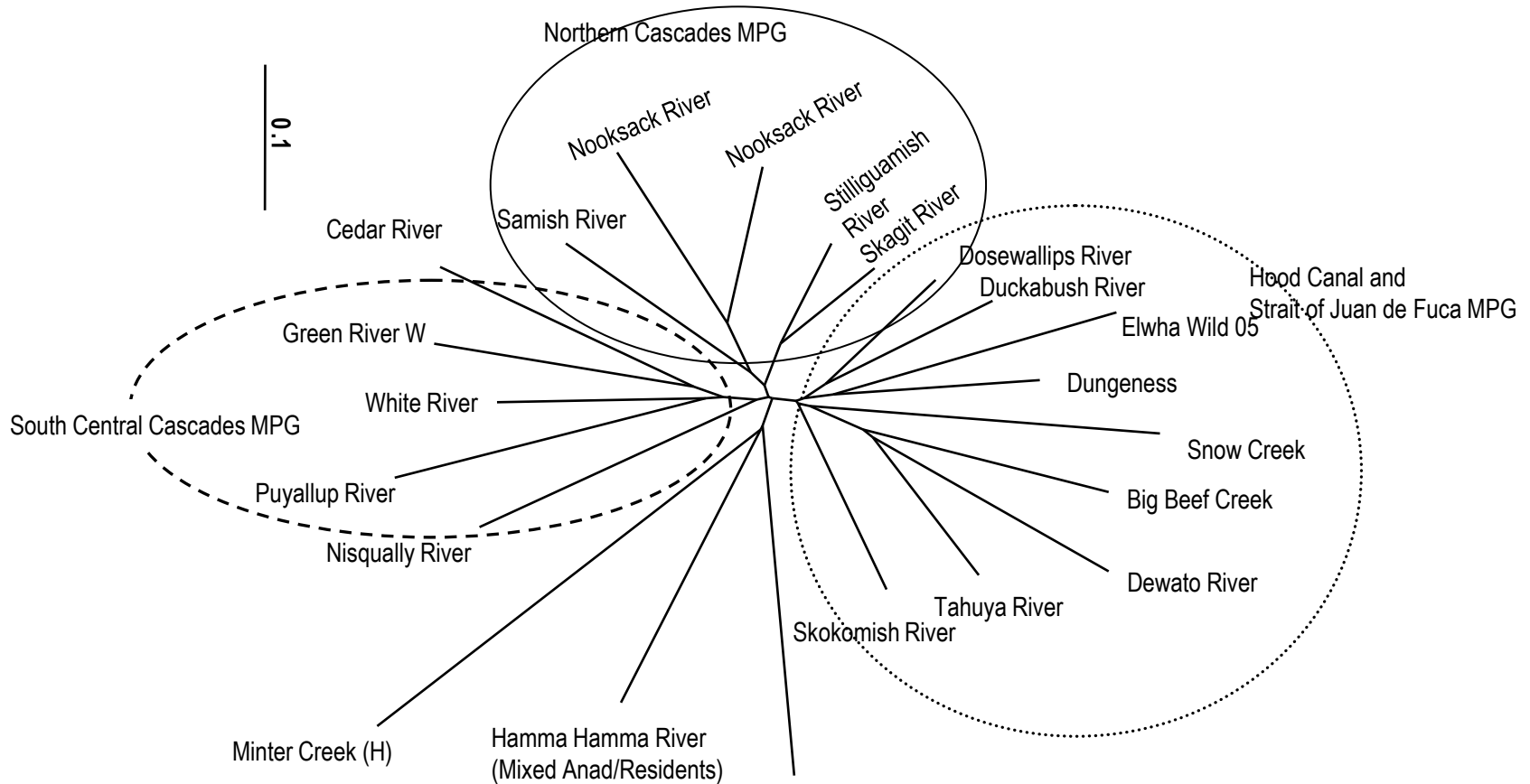
		POP_1	POP_2	POP_3	POP_4	POP_5	POP_6	POP_7	POP_8	POP_9	POP_10
E Hood C	POP_1	0	0.22422	0.276725	0.27627	0.192054	0.32734	0.26003	0.285882	0.280322	0.286164
W Hood C	POP_2	0.22422	0	0.221446	0.252898	0.238785	0.289044	0.215283	0.256906	0.241743	0.245204
Skokomish	POP_3	0.276725	0.221446	0	0.281614	0.282103	0.303785	0.258416	0.313629	0.285213	0.294091
Snow	POP_4	0.27627	0.252898	0.281614	0	0.282242	0.345242	0.283369	0.321052	0.291876	0.319159
Tahuya	POP_5	0.192054	0.238785	0.282103	0.282242	0	0.341022	0.270277	0.286171	0.291943	0.299414
Puyallup	POP_6	0.32734	0.289044	0.303785	0.345242	0.341022	0	0.230843	0.294474	0.319542	0.289932
White	POP_7	0.26003	0.215283	0.258416	0.283369	0.270277	0.230843	0	0.258035	0.286888	0.216689
Nisqually	POP_8	0.285882	0.256906	0.313629	0.321052	0.286171	0.294474	0.258035	0	0.306498	0.297183
Elwha	POP_9	0.280322	0.241743	0.285213	0.291876	0.291943	0.319542	0.286888	0.306498	0	0.308999
Green	POP_10	0.286164	0.245204	0.294091	0.319159	0.299414	0.289932	0.216689	0.297183	0.308999	0
Skamania H	POP_11	0.412706	0.370619	0.394588	0.446388	0.437625	0.40821	0.382943	0.399713	0.418636	0.416368
Dungeness	POP_12	0.243153	0.16949	0.249072	0.251927	0.239008	0.285152	0.228604	0.274427	0.220238	0.264104
Minter	POP_13	0.419285	0.396395	0.43643	0.438207	0.431098	0.455574	0.424696	0.443317	0.428818	0.448291
Cedar	POP_14	0.322341	0.279255	0.316655	0.334837	0.318299	0.295857	0.243325	0.320326	0.334763	0.248451
Stillaguamish	POP_15	0.245558	0.199244	0.259532	0.28187	0.270271	0.276437	0.197018	0.272815	0.258143	0.242932
Nook 2	POP_16	0.28057	0.263603	0.311068	0.324877	0.289441	0.325268	0.244028	0.304244	0.306521	0.27827
Skagit	POP_17	0.230101	0.189786	0.249615	0.270202	0.246227	0.274798	0.176665	0.263184	0.264063	0.216892



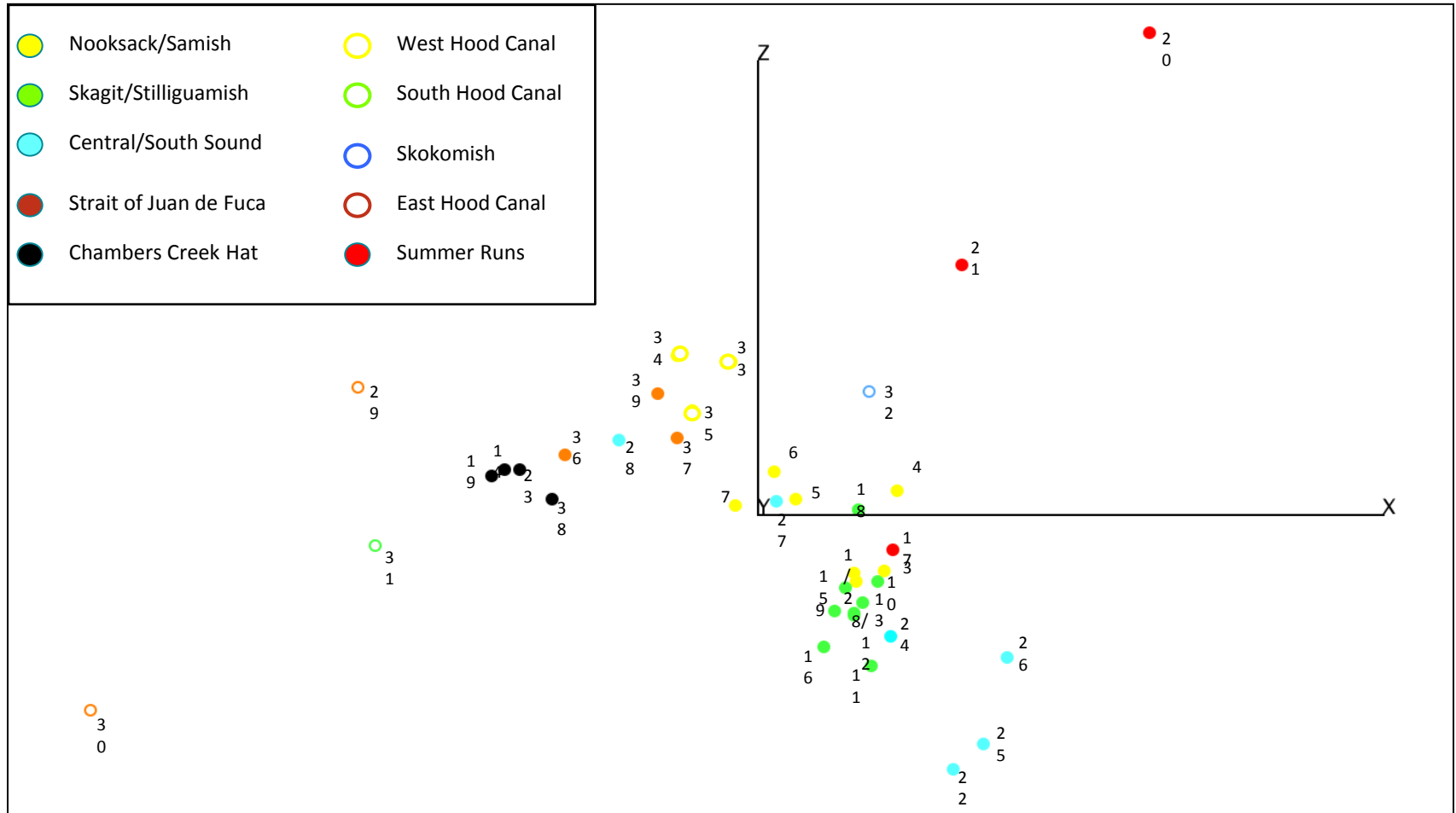
Information Resources: Genetics



Information Resources: Genetics



DIP Determination: Genetics PCA



Genetics: Principal Component Analysis

<http://www.nwfsc.noaa.gov>



Information Resource: Punch Cards

RIVER GOLDENROUGH CREEK 1048
TYPE WATER-RUN

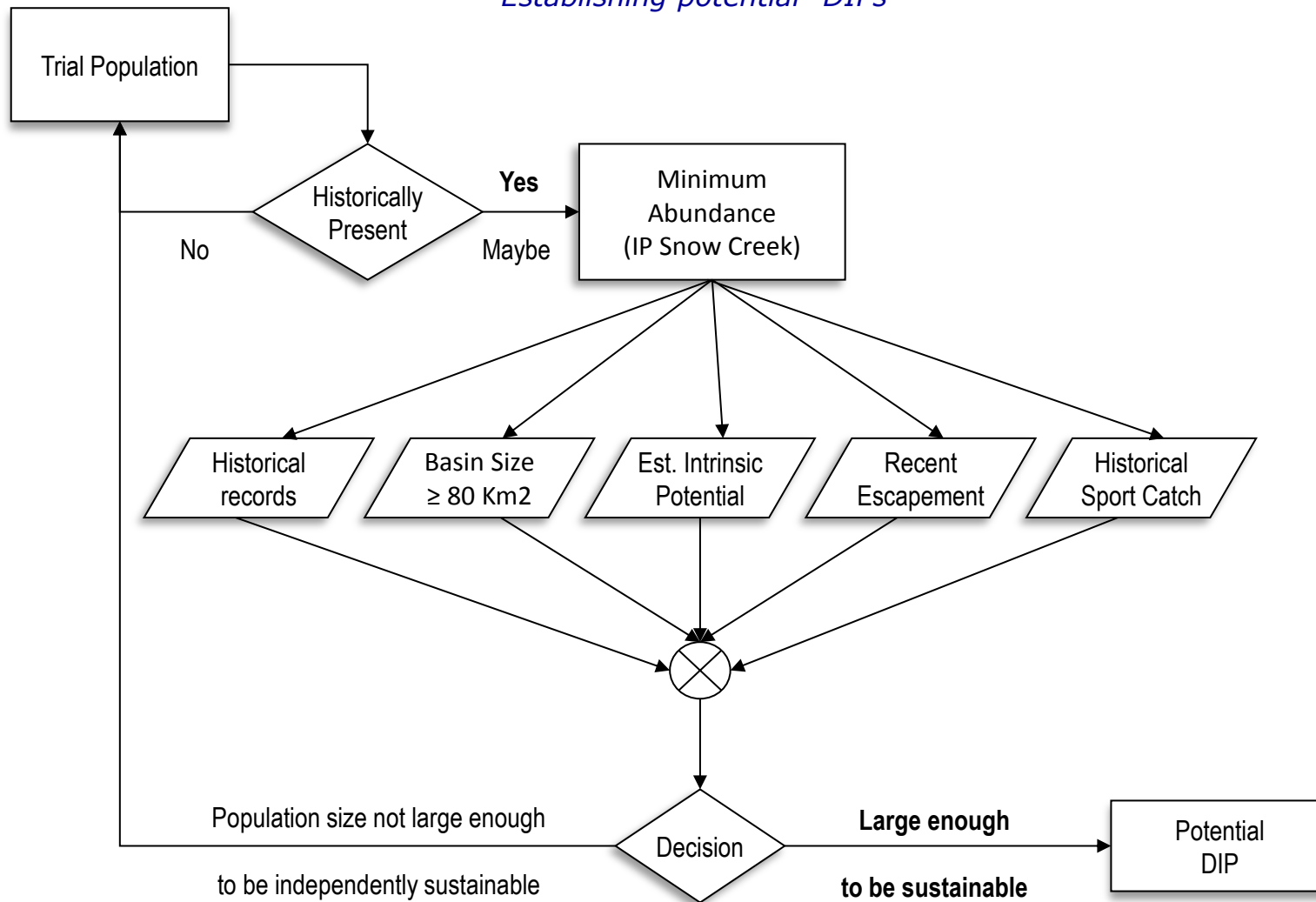
<u>SMOLT YEAR-CLASS</u>	<u>NO. SMOLTS PLANTED</u>	<u>ESTIMATED CATCH TOTAL</u>	<u>BREAKDOWN FROM PUNCHCARDS HATCHERY</u>	<u>NATIVE</u>
1946		2	—	2
1947		51	—	51
1948		20	—	20
1949		26	—	26
1950		42	—	42
1951		15	—	15
1952		83	—	83
1953		57	—	57
1954		96	—	96
1955		18	—	18
1956		36	—	36
1957	3600	63	24	39
1958		28	—	28
1959		26	—	26
1960		44	—	44
1961		51	—	51
1962		147	—	147
1963	4110	138	—	—
1964		85	—	85
1965	5082	208	—	—
1966	4290	85	—	—
1967		68	—	68
1968		47	—	47
1969	3060	83	—	—
1970	1272	305	—	—
1971				
1972				

Establishing presence
Estimating abundance



DIP Determination: Candidate DIPs

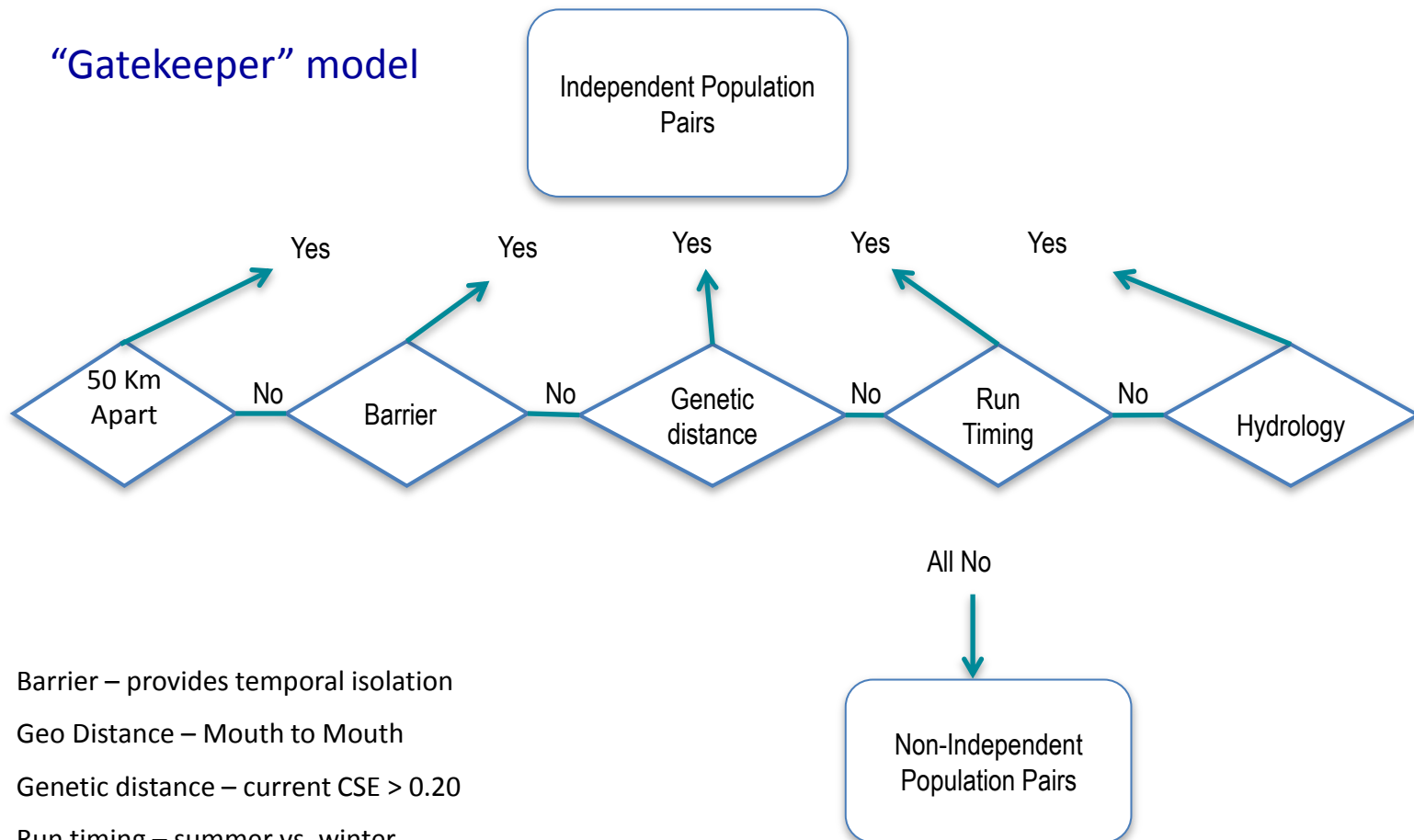
Establishing potential "DIPs"



DIP Determination: Population Determinants

Determining demographic independence

“Gatekeeper” model



Barrier – provides temporal isolation

Geo Distance – Mouth to Mouth

Genetic distance – current CSE > 0.20

Run timing – summer vs. winter

Hydrology – Gower Index, elevation & % glacial

DIP Identification – Data Availability

Population Name	DIP Criteria								VSP Data				
	Tier 1			Tier 2 and 3									
	Historical Presence	Sustainability (Abundance)	Demographic Independence	Basin Size (IP)	Temporal Isolation	Geographic Isolation	Life History (xpt run type)	Genetics	Habitat Type	Abundance Data ¹	Genetics Data	Age Data	Punch Card Data
Baker River	✓	✓		✓	?						✓		
Canyon Creek	✓				★								✓
Cedar River	✓			✓		★			★	✓	✓		✓
Deer Creek	✓	✓		✓	★			✓			✓	✓	✓
Drayton Harbor	✓			✓		★	✓		★				✓
Dungeness River	✓			✓				★	★		✓		✓
East Hood Canal Tributaries	✓		✓	✓				★	★	✓	✓		✓
East Kitsap Peninsula Tributaries	✓			✓					✓				✓
Elwha River	✓			✓				✓		✓	✓		✓
Green River	✓	✓		✓		★		✓		✓	✓	✓	✓
Nisqually River	✓			✓				★	★	✓	✓	✓	✓
Nookachamps Creek	✓			✓					★				
Nooksack River	✓	✓		✓				★	★		✓	✓	✓

Information Resources: Prior Work



Puget Sound Chinook Salmon TRT

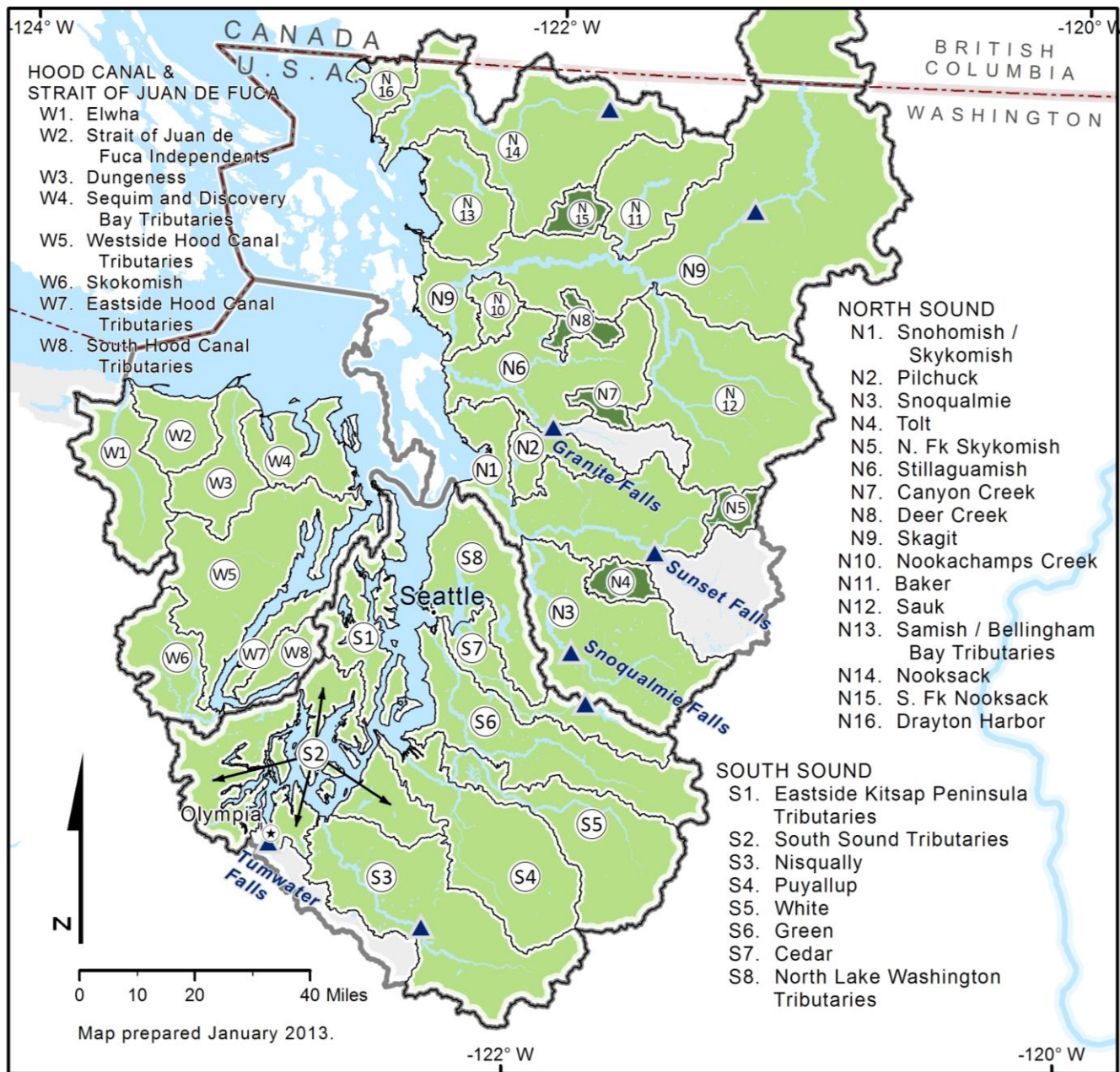
Identified 5 MPGs

Identified 22 DIPs

Recognized importance of
Early (spring) and Late (fall)
Life Histories

SaSSI

53 Steelhead populations



Puget Sound Steelhead

Oncorhynchus mykiss

Major population group



Population



Run type

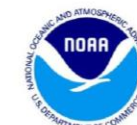
winter

summer

Major barrier

▲ waterfall / cascade

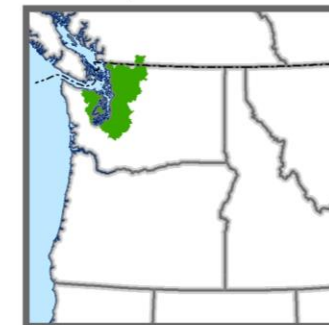
DPS, MPG, and population data developed by NMFS Northwest Regional Office and NMFS Northwest Fisheries Science Center, 2011.



National Marine Fisheries Service

Northwest Fisheries Science Center

These maps are for reference only.



NOAA FISHERIES

Drayton Harbor W
Nooksack R W
Samish R/Bellingham Bay W
Skagit R S/W
Nookachamps Cr W
Baker R S/W
Sauk R S/W
Stillaguamish R W
Snohomish/Skykomish W
Pilchuck R W
Snoqualmie R W

SF Nooksack R S
Deer Cr S
Canyon Cr S
NF Skykomish R S
Tolt R S

N Lk Washington/Sammamish W
Cedar R W
Green R W
Puyallup/Carbon W
White R W
Nisqually R W
South Sound Tributaries W

East Kitsap W
East Hood Canal W
South Hood Canal W
Skokomish R W
West Hood Canal W
Sequim/Discovery Bay W
Dungeness R S/W
Strait of Juan de Fuca W
Elwha R S/W



Existing Population Structure for DPS/ESUs

DPS/ESU	MPGs	DIPs	Viable DIPs per MPG	% DIPs Viable
Puget Sound Chinook Salmon	5	22 (31)	2-4 (14 Tier 1 in Plan)	63% 45 %
LCR Chinook Salmon	6	32	12	37.5%
LCR Steelhead	4	23	8	34.7%
UWR Chinook Salmon	1	7	2	28.5%
UWR Steelhead	1	4	2	50.0%
Interior Columbia	1	1	-	66.0%
Interior Columbia	>1		>50%	>50%
ONCC	>1		>50%	>50%

Puget Sound Steelhead

MPG	Life History	Number of DIPs	Number Viable	% DIPs Viable
Northern Cascades	Summer	5	2	40.0%
	Winter	11	5	45.4%
South and Central Puget Sound	Summer	0	0	na
	Winter	8	4	50.0%
Olympic Peninsula	Summer	0	0	na
	Winter	8	4	50.0%
Total		32	15	46.9%

A number of winter-run DIPs contain summer run elements that could not be identified as distinct populations.



Loose Ends: Placeholders for further action

DIPs that may require further review, when information becomes available

- Summer run fish not isolated by obvious barriers

 - Dungeness

 - Sauk

- Remnant summer run populations

 - Finney Creek/Day Creek

 - Skokomish River

- Residualized populations

 - Baker River summer run

 - Green River summer run

 - Elwha River summer run

- Small Basin Populations